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PATTERN OF ANTIBIOTIC USE IN DERMATOLOGY CLINIC: AN AWARE BASED CROSS-SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL IN SOUTH INDIA

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ABSTRACT

Background

Antimicrobial resistance (AMR) is a steadily worsening and silent pandemic, posing a great challenge to public health for effective disease control. The Access, Watch, Reserve (AWaRe) classification of antibiotics was launched by World Health Organisation (WHO) as a part of Global Action Plan on AMR to optimise antibiotic use. Antibiotics should be ideally prescribed from Access group to curb resistance. Monitoring antibiotic prescribing data will help to develop evidence-based guidelines to promote rational antimicrobial therapy. This study assessed the pattern of antibiotic use in dermatology clinic in a tertiary care hospital using WHO AWaRe classification.

Methods

We conducted a cross-sectional study on 112 outpatients who received antibiotics in dermatology clinic using a consecutive sampling method. After obtaining informed consent, prescriptions written by dermatologist were observed and data was entered in the predesigned semi-structured case proforma. Data analysis was done using SPSS IBM 27 software.

Results

A total of 180 antibiotics were prescribed for 12 different dermatological disorders. As per WHO AWaRe tool, 73(69.5%) of antibiotics belonged to Access group, followed by Watch 31(29.5%) and Reserve group 1(1%). Doxycycline 33(29.5%) was the most commonly prescribed antibiotic followed by amoxicillin-clavulanic acid 28(25.0%).

Conclusion

Our study findings align with the target set by WHO that by the year 2023, at least 60% of overall antibiotic use should be from Access group to combat rising resistance and preserve their efficacy. This study will help in generating guidelines for rational antibiotic prescribing policy in hospitals and ultimately benefit patients to receive optimal drug therapy.

Key-words: AWaRe, antibiotic, antimicrobial resistance, dermatology, outpatient, tertiary care hospital, India

INTRODUCTION

Antimicrobial resistance (AMR) has been declared by WHO as one of the top ten public health threats faced by humanity. Inappropriate prescription and use of antibiotics is a major factor contributing to AMR. By the year 2050, AMR infection rates could escalate to ten million cases.[1] The AWaRe classification of antibiotics was introduced by WHO Expert Committee on Selection and Use of Essential Medicines in 2017 as part of Global Action Plan on AMR to support antibiotic stewardship efforts ensuring rational use of these lifesaving drugs.[2,3] AWaRe classification categorises antibiotics into access, watch and reserve groups based on the antimicrobial spectrum of these drugs and the chances of development of resistance. Antibiotics belonging to access group have less chance for developing AMR as they have a narrow antimicrobial spectrum of activity. WHO recommends the use of these drugs for the empiric treatment of infections where the drug is chosen based on the medical history of the patient and taking into account the most common pathogen which is most likely responsible to cause the infection in that particular setting. The access category of antibiotics must be widely available and should be of low cost. Watch antibiotics should be used in the hospital facility setting for sicker patients as they have a greater chance for development of AMR. WHO cautions that utmost care should be taken to avoid the overuse of these drugs. The last-resort antibiotics are those belonging to reserve group which should only be used to treat severe resistant infections caused by multidrug-resistant organisms.

Skin diseases affect nearly one-third of the world population and this disease burden is often underestimated and neglected (WHO, 2023). This ubiquitous health concern ranks as the fourth most common cause of human disease, trailing only cardiovascular diseases, respiratory infections, and musculoskeletal disorders. [4,5] There are more than 2000 different types and presentations of dermatological diseases.[6]

It is estimated that 80-90% of total antimicrobial use occurs in the outpatient settings.[7] The Centers for Disease Control and Prevention (CDC) 2022 annual report states that 236.4 million outpatient oral antibiotic prescriptions which is equivalent to 709 antibiotic prescriptions per 1000 persons were prescribed by healthcare professionals of which, dermatology outpatient clinics alone contributed 5.4 million prescriptions.[8] WHO has set a target that at least 60% of antibiotic use should be from the access group by the year 2023, to curb the rising AMR and ensure safe and effective use of antibiotics.[9] Analysing antibiotic prescribing data from around the globe will help in recognising areas where strategies are needed to devise guidelines for rational use of these drugs. However adequate data are lacking on antibiotic use in patients at the point of care and from lower-income countries (WHO). The objective of this study was to evaluate the pattern of antibiotic use in dermatology clinic in a tertiary care hospital using WHO AWaRe classification.

MATERIALS & METHODS

A cross-sectional study was conducted in the dermatology outpatient clinic of a tertiary care teaching hospital in South India over a period of three months. The study was conducted after getting Institutional ethics committee approval (HEC. No. 14/ 29/2023/MCT dated 20/09/2023). Sample size was calculated using statistical software, nMaster v 2.0, applying formula for estimation of proportion. The assumption of proportion for less common antibiotic used was taken from the reference study.[10] In the reference study, penicillin was the less commonly prescribed drug with proportion of 24.7%. For estimating it with an absolute precision of 8% at confidence level of 95%, sample size required was 112.

A consecutive sampling method was used where patients attending dermatology outpatient clinic who were prescribed antibiotics were recruited till required number of participants was attained. After obtaining informed consent from patients, prescriptions written by the dermatologist were observed and data was manually entered by investigators into the predesigned semi-structured case proforma. The demographic characteristics of the patient, name of antibiotic and the dermatological disorder for which it was prescribed, concomitant drugs, co-morbidities and adverse drug reactions if any, were noted. Antibiotics were recorded as their generics in the WHO Aware list of antibiotics and grouped

as “access”, “watch”, “reserve” or “not recommended”. Prescriptions of more than one antibiotic were grouped according to their respective classes separately. The data collected was then entered in Microsoft excel sheet and analysed using SPSS IBM 27 software. Quantitative variables were expressed as mean and standard deviation and categorical variables were described by percentage distribution. We also verified whether the antibiotics prescribed were in the WHO Model List of Essential Medicines – 23rd List (2023). Confidentiality and anonymity of the patient’s information were maintained during and after the study.

RESULTS

The age range of the patients included in the study was 1-88 years. The mean age of the study population was 38.37 ± 19.78 years. Most of the patients were in the age group of 21-30 years (24.1%). The demographic profile of the study population is shown in Figure 1. Analysis of gender wise distribution revealed that majority of patients were females 61(54.5%) out of the 112 patients. Interestingly females were found to be more than males in all age groups as depicted in figure 1. There were associated co-morbidities in 50 (33%) patients, of which hypertension 19 (16.9 %) and diabetes mellitus 18(16 %) were the most common. Out of the 112 patients, 10 (8.9%) were smokers and 12 (10.7%) patients consumed alcohol. We also found that 2(1.8%) patients had history of drug allergy. A total of 360 drugs were prescribed for the 112 patients who attended the outpatient clinic and received a prescription containing at least one antibiotic. The most commonly prescribed drugs were antibiotics 180 (50%). The most preferred route was oral 105 (58%) followed by topical 75(42%). Interestingly 180 drugs were given concomitantly with antibiotics.

The antibiotics were prescribed for 12 different dermatological disorders of which eczema and dermatitis 28 (25%) were the most common followed by psoriasis 16(14.3%) and acne 15(13.4%) as seen in Figure 2. Antibiotics were given for 44 (39.3%) of the 112 patients for primary bacterial infections. Among the 68 (60.7%) secondary bacterial infections, patients with allergic disorders 34 (30.4%) followed by autoimmune diseases 25(22.3%) topped the list followed by fungal infections 5(4.5%) and viral infections 4(3.6%).

The grouping of oral antibiotics prescribed to study population based on WHO AWaRe classification of antibiotics, 2023 is shown in Table 1. Nearly three-fourths of the antibiotics belonged to access group 73(69.5%) as shown in Figure 3. Among these, doxycycline 33(29.5%) was the most commonly prescribed, followed by amoxicillin-clavulanic acid 28(25.0%) and cloxacillin 8(7.1%) belonging to beta lactam group of antibiotics as represented in Table 1. The watch group constituted about 31(29.5%) of the prescribed drugs of which azithromycin 21(18.8%) was the most common followed by cefpodoxime proxetil 5(4.5%). The reserve group included only one antibiotic linezolid 1(1.0%). There were no prescriptions from the not recommended groups. All the prescribed antibiotics were included in the WHO Model List of Essential Medicines-23rd List (2023), except the third-generation cephalosporin, cefpodoxime proxetil. Among the oral antibiotics, beta lactams 44(41.9%) were the most commonly prescribed class followed by tetracyclines 34(31.4%) and oxazolidinones 1(1%) were the least prescribed. The most commonly prescribed topical antibiotic was mupirocin 36(32.1%) followed by fusidic acid 16(14.3%) as shown in Figure 4. Of the topical antibiotics prescribed, 17.5% were given in combination with steroids as fixed doses. Antihistamines 48(42.9%) were the most commonly used drugs along with antibiotics followed by antacids 44(39.3%). Other concomitant drugs included emollients 20(17.9%), steroids 18(16.1%), and antifungals 12(10.7%). Immunosuppressants and antiviral drugs were used equally 3(2.7%). Retinoids and anti-scabies agents constituted 2(1.8%) each.

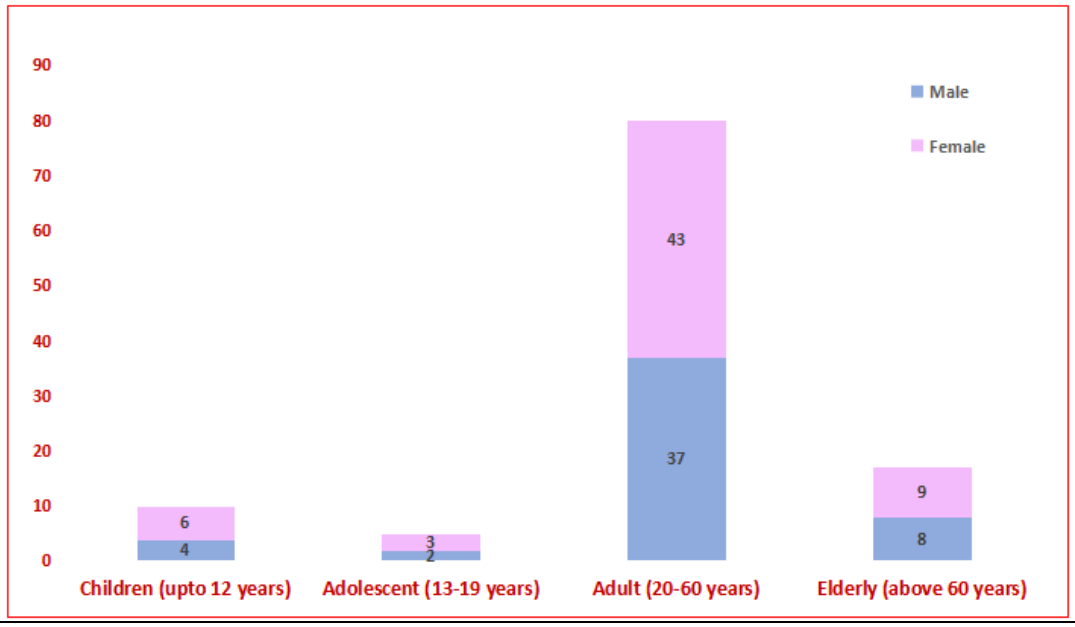

Figure 1: Demographic profile of the study population (n=112)

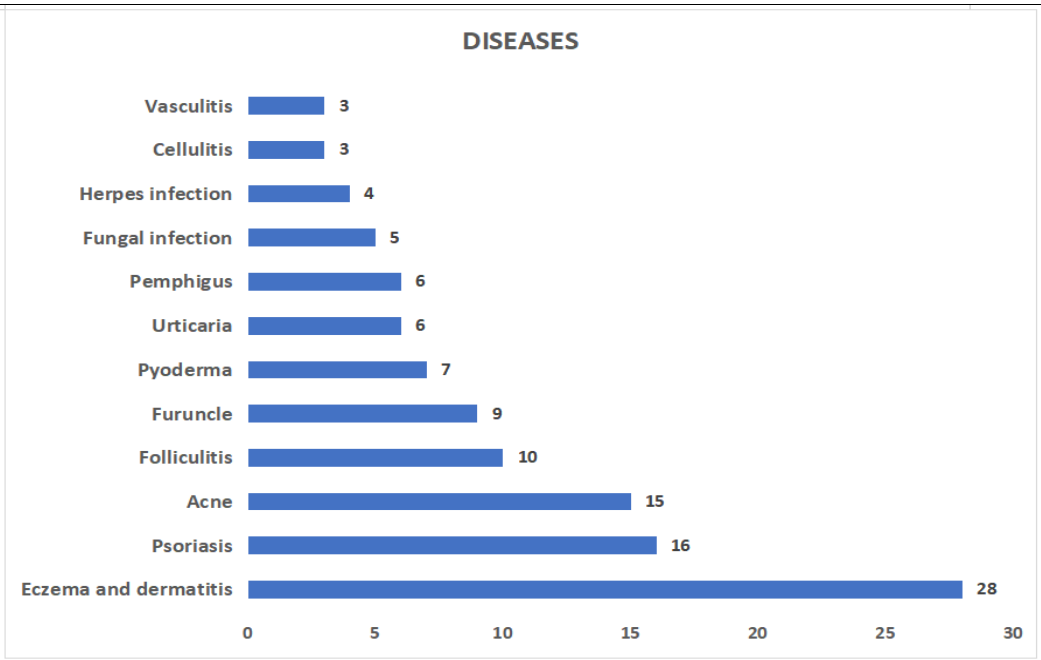

Figure 2: Incidence of Dermatological diseases in study population

Table 1: Group-wise distribution of antibiotics according to the WHO AWaRe classification

Antibiotic class	Antibiotic	AWaRe group	Included in EML	Frequency	Percentage
Tetracyclines	Doxycycline	Access	Yes	33	29.5
Penicillins	Amoxicillin-clavulanic acid	Access	Yes	28	25
Macrolides	Azithromycin	Watch	Yes	21	18.8
Penicillins	Cloxacillin	Access	Yes	8	7.1
Cephalosporins	Cefpodoxime	Watch	No	5	4.5
Sulfonamide	Cotrimoxazole	Access	Yes	4	3.6
Cephalosporins	Cefixime	Watch	Yes	3	2.7
Fluoroquinolones	Ciprofloxacin	Watch	Yes	2	1.8
Oxazolidinones	Linezolid	Reserve	Yes	1	0.9

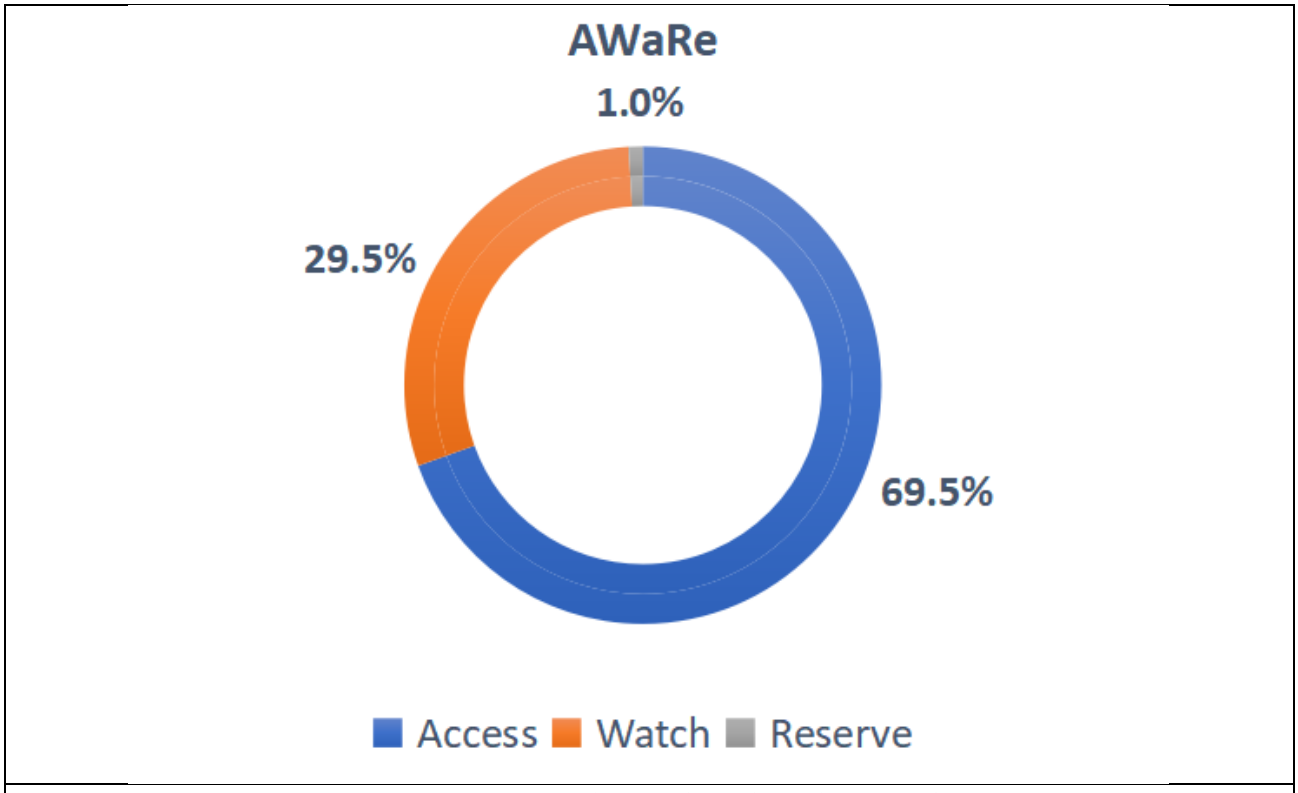

Figure 3: Percentage of antibiotics based on AWaRe classification

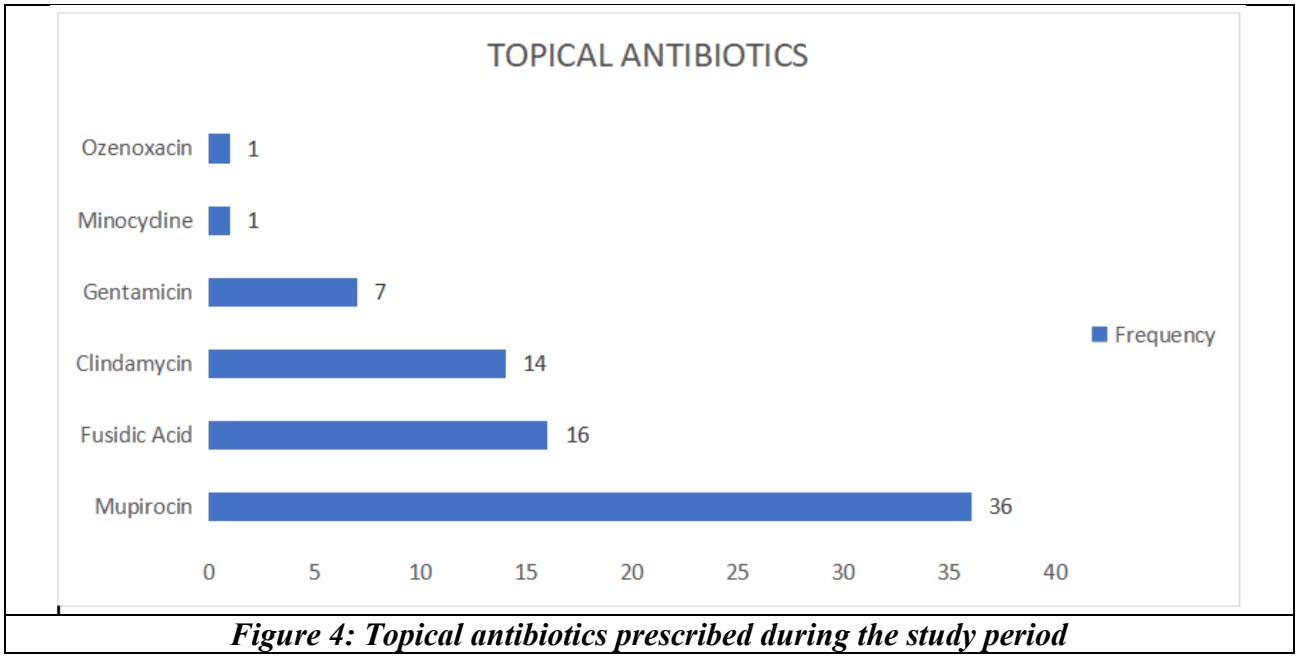

Figure 4: Topical antibiotics prescribed during the study period

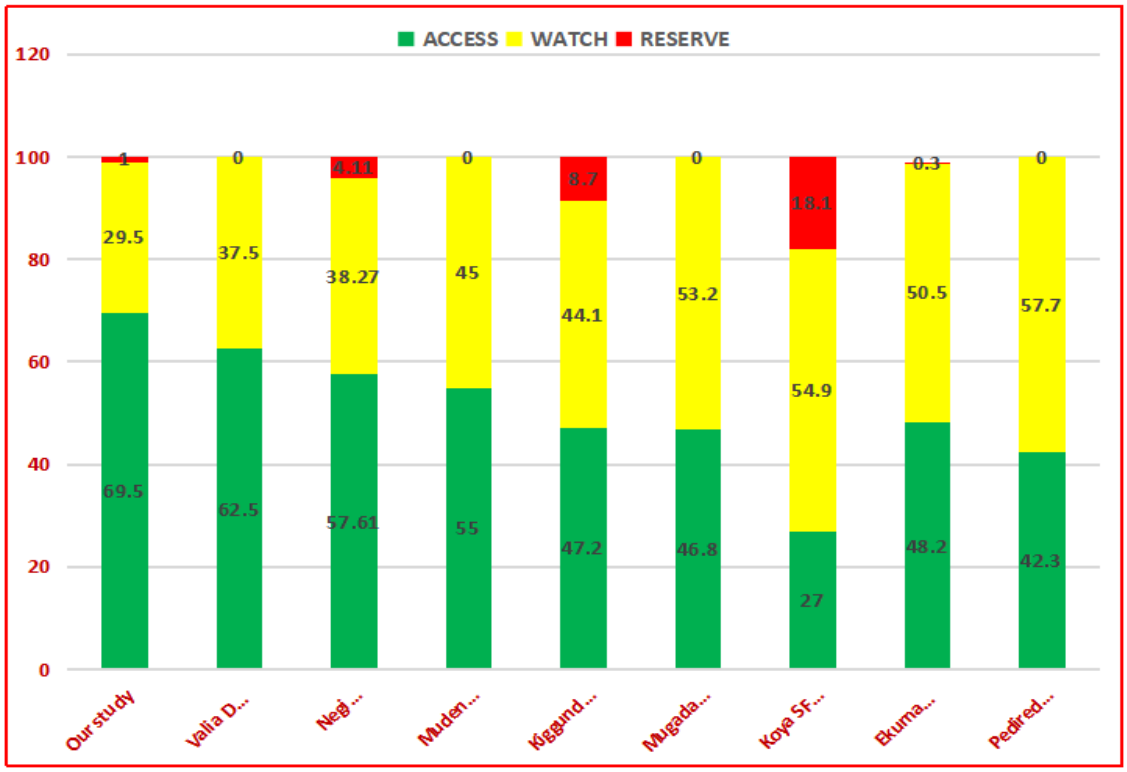

Figure 5: Comparison of use of access antibiotics with other studies around the globe

DISCUSSION

In this study, we have analysed the demographic profile and pattern of antibiotic use in dermatology outpatient clinic in a tertiary care hospital in South India according to WHO AWaRe classification of antibiotics for evaluation and monitoring of use, 2023.

A total of 12 different dermatological disorders were observed among patients of the current study which included both infectious and non-infectious diseases. Antibiotics were used for primary bacterial infections for 44 (39.3%) of the 112 patients. Our findings were similar to an inpatient study conducted by Divyashanthi CM et al.[11] at Karaickal, Puducherry. They too observed that primary bacterial infections were less compared to secondary bacterial infections in already existing dermatological conditions.

Dermatological disorders are managed with topical, oral and parenteral drugs based on severity. Topical treatment is preferable as this will minimise side effects and the chances of developing resistance. Antimicrobials such as dapsone, tetracyclines and macrolides are used in dermatology considering their anti-inflammatory properties for non-infectious conditions as well to treat diseases like acne, rosacea and autoimmune bullous lesions.[12] Tetracyclines can inhibit overactive inflammation to the commensal organism *Propionibacterium acnes* in acne vulgaris. Erythromycin, minocycline and co-trimoxazole are some of the other systemic antibiotics used for the treatment of this very common dermatological condition.

However, the use of antimicrobials over time results in the creation of "superbugs" which no longer respond to these agents and this is when the problem of AMR arises, making conditions harder to treat. To combat the escalating AMR, WHO has set a target that at least 60% of antibiotics used should be from Access group by the year 2023. Our study objective aligns with this global initiative as we found that most of the prescribed antibiotics belonged to access category 73(69.5%). The use of only 1(1%) reserve antibiotic in a tertiary hospital which also receives resistant infectious cases from peripheral health centres is a promising sign.

Examining variations in antibiotic prescribing in different studies across the world will help in identifying areas where measures are needed to improve prescription practices. The use of access, watch and reserve antibiotics obtained in our study was compared with similar studies around the

globe as shown in Figure 5. Even though a study conducted by Valia D *et al*.[13] in a rural hospital in South Africa attained the WHO target of 60%, the percentage use of access antibiotics (62.5%) was less when compared to our finding of 69.5%. But unlike the 1% antibiotics from reserve group found in our study, theirs did not yield any reserve antibiotic.

Many studies around the globe reveal that the 60% target set by WHO is not attained though they showed the use of more access antibiotics than watch group as evident in Figure 5. In a study conducted on inpatients by Negi, Gunjita *et al*. [14] in a tertiary care hospital in North India, access antibiotics 140(57.61%) contributed more than watch antibiotics 93(38.27%) and reserve antibiotics 10(4.11%). A cross-sectional Study conducted by Mudenda *et al*. [15] in primary healthcare hospitals in Zambia also revealed that access group (55%) of antibiotics were prescribed more than watch antibiotics (45%). These findings are similar to the study conducted in Uganda by Kiggundu *et al* [16] where the access group antibiotics (47.2%) though prescribed more than watch group (44.1%), did not meet the WHO recommendations.

Our result, however, was found in contrast to multiple studies done around the world which showed an increased use of watch antibiotics in their study population. A higher prevalence of watch antibiotics (53.19%) was found in a similar outpatient study conducted in a tertiary hospital by Mugada, Vinodkumar *et al*.[17] while access antibiotics accounted for only 46.80%. A cross- sectional study conducted by Koya SF *et al*.[18] which analysed drug sales data set from private sector also showed a higher usage of watch antibiotics (54.9%) while access antibiotics were only 27%. A similar study in a tertiary hospital conducted by Agantem Ekuma *et al*.[19] also establishes that watch antibiotics contribute to 50.5% of prescriptions while access antibiotics lag behind at 48.2%. They are of the observation that severity of infections may have influenced lower usage of access drugs. The study conducted in Telengana, India by Peddireddy *et al*.[20] in general surgery specialities also reported an increased use of watch antibiotics (57.7%) than of access group (42.3%).

Stratification by World Bank country classification in a point prevalence survey conducted in adult wards of 69 countries by Pauwels *et al*.[21] showed that low-income countries had the highest prescription of access antibiotics (62.8%) and the lowest watch group (36.0%). The survey did not find any reserve antibiotics in prescriptions. Contrasting data was obtained from middle- and high-income countries which showed high use of watch and reserve antibiotic in the population which was attributed to urbanisation that might be increasing infection rates demanding the use of these drugs. The situation is further worsened by easier access to antibiotics in these regions that will add on to global AMR. The survey showed alarming findings that large numbers of reserve antibiotics were prescribed empirically worldwide. Similar findings were obtained in the study conducted by Yin, Jia *et al*.[22] in Shandong province, China which showed that access antibiotics were prescribed and consumed more by the upper middle and lower economy regions that depended on the primary healthcare centres. On the other hand, hospitals in higher income regions showed an increase in use of watch antibiotics. These data underline the finding of Pulcini *et al*.[23] that a major concern faced by countries worldwide irrespective of economic status is the lack of sustained availability of antibiotics of adequate quality at an affordable cost. The low rate of usage of access category of antibiotics may be attributed to nonavailability of these essential drugs pressurising the health care provider to resort to the use of available drugs in the facility. This is a situation faced commonly by middle- and low-income countries which also lack adequate laboratory services and man-power and will thus have to rely more on empirical treatment of infections. Irrational prescribing of watch antibiotics will escalate the chances of AMR that might necessitate the use of reserve antibiotics.

Several attempts are being made around the globe to prevent overuse of antimicrobial agents and alert the world to tackle this crisis of AMR. Many studies have revealed that injudicious prescribing of antibiotics often occurs due to lack of awareness of health care workers about the AWaRe tool.[24] The microbiology department of a tertiary care hospital in South India has conceptualized and implemented a new antimicrobial stewardship tool in the form of an AWaRe-based bacterial culture sensitivity reporting format.[25] The list of Access, Watch, and Reserve classes of antibiotics are

included in the format as a quick reference for the health care provider. This will help the physicians to select appropriate antibiotics from access group easily.

Since information about regional patterns of drug resistance is important in selecting a therapeutic agent, Antimicrobial Stewardship Program (ASP) team must be constituted by every health care facility to identify specific pathogens and resistance patterns which are commonly seen in that particular area and alert health care workers. The team will formulate guidelines for empiric antibiotic usage based on local antibiogram studies and guide the use of antibiotics. Strict regulations should be enforced to restrict over-the-counter sale of antibiotics. Illegal manufacturing and marketing of fixed-dose combinations (FDC) of antibiotics should be curtailed by law. WHO has released WHO AWaRe (Access, Watch, Reserve) antibiotic book for each infection for children and adults as a quick-reference guide for health professionals at the point of care. (WHO 2022).

Integration of public health, veterinary, and environmental health sectors known as the One Health approach is needed to tackle this threat of AMR as microorganisms spread in and between all sectors. Denmark and other countries of European Union have imposed restrictions on use of several antimicrobial agents in food, animals and humans by systematic and continuous monitoring of antimicrobial drug resistance and research activities related to Danish Integrated Antimicrobial Resistance Monitoring and Research Program (DANMAP).[26]

It must be recognized that AMR is an issue that transcends national borders and it is the collective responsibility of humanity to preserve the efficacy of these life saving agents for the protection of present and future generations.

CONCLUSION

Most of the antibiotics prescribed in this study belonged to access group. Data generated from prescription studies like ours and local antibiogram studies will guide policy makers for inclusion of access antibiotics in the essential medicine list and ensure their availability. Lack of standard treatment guidelines to tackle high burden of infectious diseases in healthcare facilities and non-adherence to existing protocols due to prescriber preferences are major concerns to be addressed. Health care workers should be made aware of the AWaRe tool and antibiotics should be made available to the public only on the prescription of a Registered Medical Practitioner. The study also highlights the need for continuing similar research to identify the lacunae where measures are needed to improve prescription practices.

REFERENCES

[1] O'Neill J. Antimicrobial resistance: tackling a crisis for the health and wealth of nations. London: Review on Antimicrobial Resistance; 2014. Available from: https://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf;

[2] World Health Organization. Global action plan on antimicrobial resistance. Available from: https://www.who.int/publications/i/item/9789241509763.

[3] World Health Organization. In the face of slow progress, WHO offers a new tool and sets a target to accelerate action against antimicrobial resistance. Available from: https://www.who.int/news/item/18-06-2019-in-the-face-of-slow-progress-who-offers-a-new-tool-and-sets-a-target-to-accelerate-action-against-antimicrobial-resistance.

[4] Karimkhani C, Dellavalle RP, Coffeng LE, Flohr C, Hay RJ, Langan SM, et al. Global skin disease morbidity and mortality: an update from the Global Burden of Disease Study 2013. JAMA Dermatol 2017;153(5):406-12.

[5] Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015;386(9995):743–800.

[6] Sastry AS, Bhat S. Essentials of Medical Microbiology. 3rd edn. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd 2022:504-5.
[7] Suda KJ, Hicks LA, Roberts RM, Hunkler RJ, Danziger LH. A national evaluation of antibiotic expenditures by healthcare setting in the United States, 2009. Journal of Antimicrobial Chemotherapy 2013;68(3):715–8.
[8] Centers for Disease Control and Prevention. Outpatient antibiotic prescriptions - United States, 2022. Available from: https://archive.cdc.gov/#/details?url=https://www.cdc.gov/antibiotic-use/data/report-2022.html
[9] Zanichelli V, Sharland M, Cappello B, Moja L, Getahun H, Pessoa-Silva C, et al. The WHO AWaRe (Access, Watch, Reserve) antibiotic book and prevention of antimicrobial resistance. Bull World Health Organ 2023;101(4):290–6.
[10] Bahelah SO, Abdo GM. Prescription patterns of antibiotics in five dermatologic outpatient clinics: a cross sectional study from Yemen. JPPCM 2016;2(3):65–9.
[11] Divyashanthi CM, Nandhini A, Kumar SA. Study on drug utilization pattern of antibiotics among dermatology in-patients of a tertiary care teaching hospital, Karaikal, Puducherry. Int J Basic Clin Pharmacol 2014;3(6):1072-7.
[12] Sewell MJ, Burkhart CN, Morrell DS. Goodman & Gilman's: The Pharmacological Basis of Therapeutics. 13th ed. New York: McGraw-Hill Education 2017.
[13] Valia D, Ingelbeen B, Kaboré B, Karama I, Peeters M, Lompo P, et al. Use of WATCH antibiotics prior to presentation to the hospital in rural Burkina Faso. Antimicrob Resist Infect Control 2022;11(1):59.
[14] Negi G, Kb A, Panda PK. Ground level utility of Access, Watch, Reserve classification: Insights from a tertiary care center in North India. World J Exp Med 2023;13(5):123-33.
[15] Mudenda S, Chomba M, Chabalenge B, Hikaambo CN, Banda M, Daka V, et al. Antibiotic prescribing patterns in adult patients according to the who aware classification: a multi-facility cross-sectional study in primary healthcare hospitals in Lusaka, Zambia. Pharmacology & Pharmacy 2022;13(10):379–92.
[16] Kiggundu R, Wittenauer R, Waswa JP, Nakambale HN, Kitutu FE, Murungi M, et al. Point prevalence survey of antibiotic use across 13 hospitals in Uganda. Antibiotics (Basel). 2022;11(2):199.
[17] Mugada V, Mahato V, Andhavaram D, Vajhala SM. Evaluation of prescribing patterns of antibiotics using selected indicators for antimicrobial use in hospitals and the Access, Watch, Reserve (AWaRe) classification by the World Health Organization. Turk J Pharm Sci 2021;18(3):282–8.
[18] Koya SF, Ganesh S, Selvaraj S, Wirtz VJ, Galea S, Rockers PC. Consumption of systemic antibiotics in India in 2019. Lancet Reg Health Southeast Asia 2022;4:100025.
[19] Ekuma A, Onukak A, Udoette S, Versporten A, Pauwels I, Oduyebo O, et al. AWaRe classification of antibiotics prescribed within 2018-2021 for hospitalized medical and surgical patients in Uyo, Nigeria. Pan Afr Med J 2023;46:80.
[20] Peddireddy M, Mahin J, Uppu A, Padi SSV. Hospital antibiotic prescribing pattern in general surgery specialty: analysis based on the WHO Access, Watch and Reserve (AWaRe) Classification. J Pharm Res Int 2021;7–19.
[21] Pauwels I, Versporten A, Drapier N, Vlieghe E, Goossens H, Global-PPS network. Hospital antibiotic prescribing patterns in adult patients according to the WHO Access, Watch and Reserve classification (AWaRe): results from a worldwide point prevalence survey in 69 countries. J Antimicrob Chemother 2021;76(6):1614–24.
[22] Yin J, Li H, Sun Q. Analysis of antibiotic consumption by AWaRe classification in Shandong Province, China, 2012-2019: a panel data analysis. Front Pharmacol 2021;12:790817.
[23] Pulcini C, Beovic B, Béraud G, Carlet J, Cars O, Howard P, et al. Ensuring universal access to old antibiotics: a critical but neglected priority. Clin Microbiol Infect 2017;23(9):590–2.

[24] Rahbi FA, Salmi IA, Khamis F, Balushi ZA, Pandak N, Petersen E, et al. Physicians' attitudes, knowledge, and practices regarding antibiotic prescriptions. J Glob Antimicrob Resist 2023;32:58–65.
[25] Hassan H, Jyothi R, Sreenadh H, Manjusree S, Reghukumar A. AWaRe-based culture reporting format: a novel tool for antimicrobial stewardship [Letter]. GMS Infect Dis 2023;11:Doc04.
[26] Hammerum AM, Heuer OE, Emborg HD, Bagger-Skjøt L, Jensen VF, Rogues AM, et al. Danish integrated antimicrobial resistance monitoring and research program. Emerg Infect Dis 2007;13(11):1633–9.